Recent Developments in OLED Lighting

OLED Track Session: Barriers to Low-Cost Manufacturing

Mike Lu, Director OLDC

OLED Lighting Design Center, Berkeley, CA

Outline

- Reporting from LFI and SID 2013
- NanoMarkets OLED Lighting Forecast
- High color quality – where OLEDs can compete?
- The need for a US based OLED panel manufacturer

From LightFair International

Philadelphia, PA, April 23-25

Osram TOLED luminaire

Philips
A version of Mimosa

WAC Lighting
OLED/LED hybrid sconce

Acuity: Modelo, Lumen Being, and
OLED marker lights

ABL OLED Luminaires at LFI'13

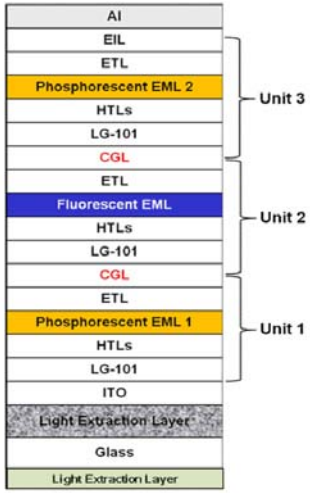
Modelo with LGC square and bar-type panels

Lumen Being with LGC bar-type panels, floor-standing and desk-mount, 2-D gestural interaction

OLED marker light series with white and amber panels from OLEDWorks

From SID Display Week

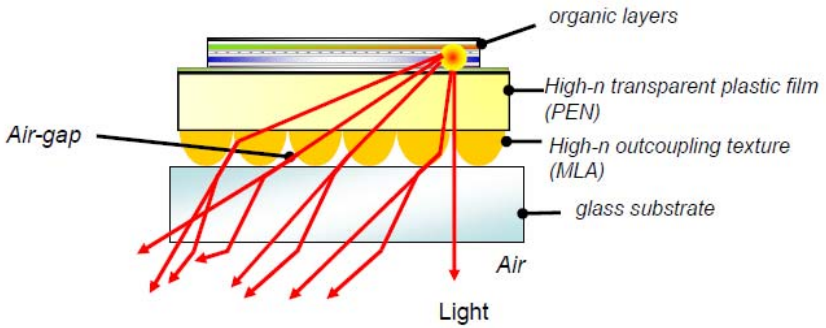
Vancouver, BC, May 20-24



Notable panel results

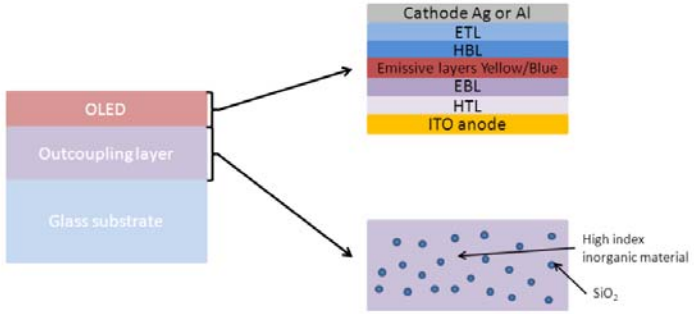
- LG Chem (paper 61.1): 3-stacked WOLED, 1.8X outcoupling enhancement (IES), 80 lm/W, targeting 100 lm/W next year

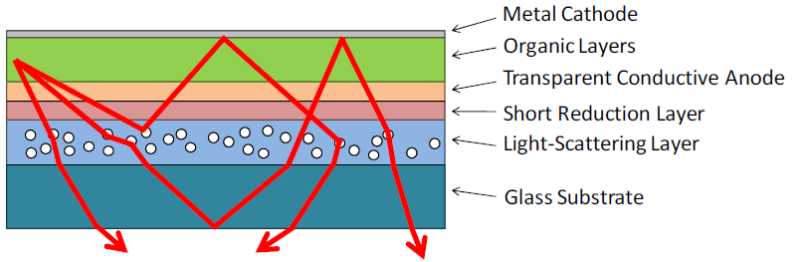
- Panasonic (paper 66.2): high-n PEN substrate with microlens, 2.5X extraction, double glass encapsulation
    - o WOLED at 87, 101, 114 lm/W depending on structure



Substrate with integrated scattering

- St Gobain (paper 43.2): SiO2 scattering center in high-n inorganic material on regular glass, 2.0 X
- AGC (paper 58.1): very high-n scattering center in high-n glass layer on regular glass, 2.1 X (now sampling)





Manufacturing equipment

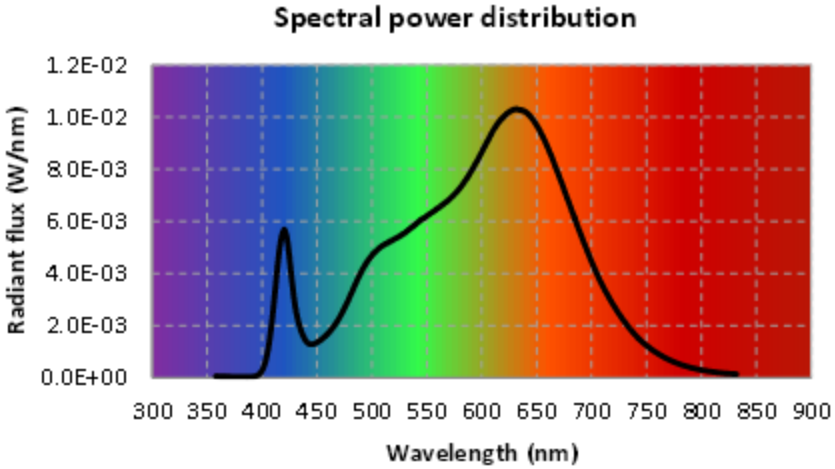
- Sunic (paper 55.4): G5 equipment meeting all productivity specs, rough price estimate at 10X G2 line

Recent Nano Markets OLED Lighting Forecast

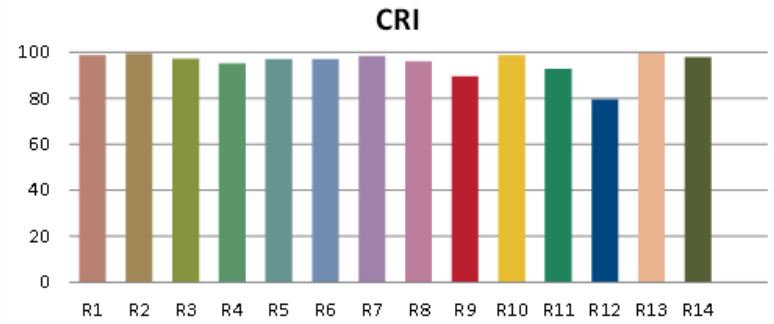
Forecast much more grounded and paints three scenarios:

1. OLED lighting prevails
   - Requires a strong industry champion
   - Suggests LG Chem to be that champion
2. OLED lighting remains a niche
   - Main issue is cost
3. OLED lighting fails

High Color Quality LEDs



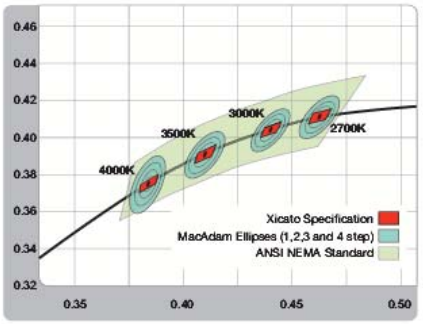
- Sorra MR16 replacements
- GaN on GaN
- Vivid series @3000K Ra 95, R9 95 40.5-43 lm/W



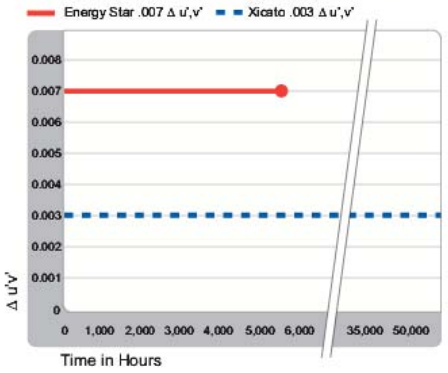
Source: Soraa

High Color Quality LEDs

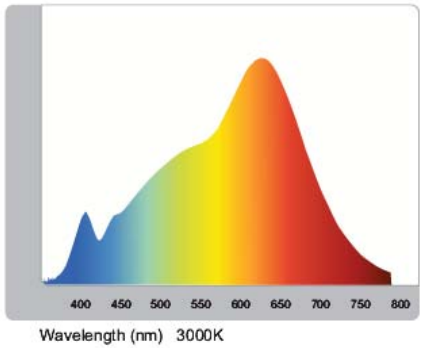
Color Consistency - Initial



Color Consistency - Maintained



Spectral Power Distribution



Color Rendering Index (Typical)

Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
98	98	99	98	98	98	97	98	98	98	99	98	88	98	98	98

Source: Xicato

- Xicato Artist series modules
- Remote phosphor design with 2 (?) phosphors
- Very high CRI, round module efficacy at 47-59 lm/W, rectangular module efficacy at 50-64 lm/W

OLED Panel with High Color Quality

- We expect efficacy loss for narrow line width LEDs to achieve the full-spectrum result with multiple phosphors
- OLEDs may have an opening due to its intrinsic broad emission
  - Target CRI Ra 90+, R9 50+
  - Slight lower CRI than a perfect blackbody emitter but easier to achieve and the visual difference is minor
  - Aim to better LED efficacy at this color quality